TASMANIAN ASSESSMENT, STANDARDS & CERTIFICATION

External Assessment 2025

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BIOLOGY

BIO315124

Section A

Pages: 12
Questions: 5
Information Sheet: 1

Preparation time for this exam: 15 minutes

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each question.
- Write your answers in the spaces provided in this exam paper.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
- The Biology Information Sheet can be used throughout this exam.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use	
C3	/ 36

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Guide to Exam Structure

	Questions available	Questions to answer	Suggested working time	Marks available
Section A	5	5	36 minutes	36 marks
Section B	6	6	36 minutes	36 marks
Section C	6	6	36 minutes	36 marks
Section D	6	6	36 minutes	36 marks
Section E	6	6	36 minutes	36 marks
Totals	**29**	**29**	**180 minutes (3 hours)**	**180 marks**

Criterion

You **must** make sure your answers address:

- Criterion 3 undertake biological inquiry to generate and evaluate data.

Question 1

Marker use

Catalase is an enzyme that releases oxygen from hydrogen peroxide. Four (4) groups of students investigated the presence of catalase in different bacteria. Each group set up a petri dish with an inoculation of *E.coli*, then 5 ml of 3% hydrogen peroxide was added, and the rate of reaction was recorded.

This procedure was then repeated by each group using different bacteria. The results from the four (4) groups are given in the table below:

Bacteria	**Reaction Rate (0, 1, 2, 3)**			
	Group 1	Group 2	Group 3	Group 4
Escherichia coli	3	3	3	3
Staphylococcus aureus	3	2	3	2
Enterococcus faecalis	0	1	0	1
Listeria monocytogenes	3	3	2	3

Table 1: Rate of reaction measured by the release of oxygen bubbles from different bacteria.

Key: no reaction = 0, slight reaction = 1, medium reaction = 2, fast reaction = 3

a)

i. State the **independent variable** in this experiment.

/1

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ii. State the **dependent variable** in this experiment.

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Question 1 continues

Marker use

b) State **one (1)** hypothesis that this experiment is likely to have been designed to test.

/3

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The volume and strength of the hydrogen peroxide, and the size and the shape of the petri dishes were kept constant in this investigation.

c)

i. State **two (2)** other factors that must be kept constant.

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ii. Outline why it is important to keep **one (1)** of these **specific** factors constant.

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d) Explain why a well-designed experiment has only **one (1)** independent variable.

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Total Q1

/9

Question 2

Marker use

AIDS is a potentially fatal disease. It is caused by a virus, HIV. Newborn babies whose mothers are infected with HIV can acquire the infection from their mothers at birth. Clinical trials showed that a baby would have a reduced chance of becoming infected with HIV if a pregnant woman took the drug AZT in the last 12 weeks of pregnancy. Later it was discovered that researchers had used a placebo with one (1) group of pregnant women infected with HIV who participated in a trial. The protest from the community was enormous, and the use of placebos in human clinical trials came under much scrutiny.

a) Explain the **purpose** of using a placebo in these investigations.

/2

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b)

i. Explain **one (1)** problem with using placebos in human clinical trials.

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ii. Outline **two (2)** best practices in implementing these trials.

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Total Q2

/6

Question 3

Marker use

Two (2) types of bacteria, A and B, were isolated from a patient's throat swab and grown in pure culture on separate agar plates. On each plate there were four (4) different antibiotic discs: W, X, Y and Z.

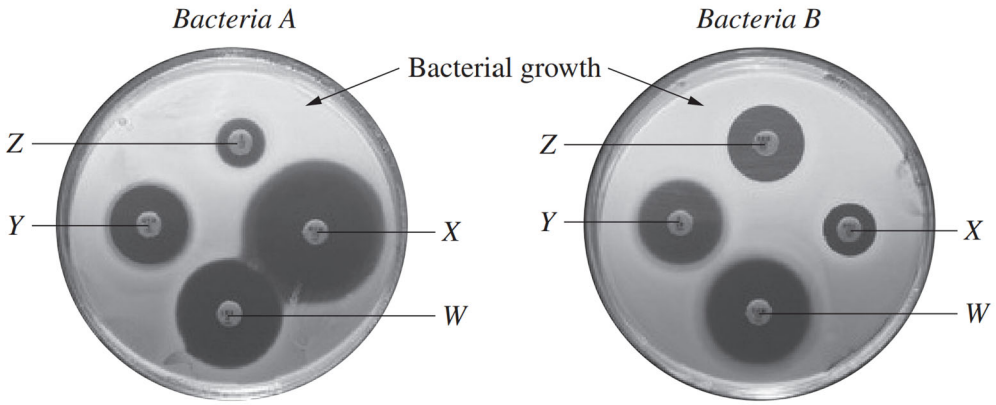

Figure 1: Bacterial plates with antibiotic discs.

a) Explain which antibiotic disc is **best** at slowing the growth of Bacteria A only.

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b) If the patient is to be given only **one (1)** antibiotic, justify which is the best choice.

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c) Outline **two (2)** ways the laboratory employee could **improve** the reliability of the patient's results.

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Total Q3

/6

Question 4

Marker use

Four (4) groups of students carried out an experiment in which the effect of glucose concentration on the fermentation rate of yeast was measured. The fermentation rate was determined by the rate of temperature change of the fermenting mixture.

Before beginning the experiment, each group practised measuring the temperature of water and checked the group's thermometer (A, B, C, D) against an electronic thermometer that gave a true measure of temperature. The following results were obtained during the practice as shown in Table 2.

Group Number (and assigned thermometer)	**Each group's thermometer readings (° C)**			**Electronic thermometer reading (° C)**
	1st measurement	2nd measurement	3rd measurement	
Group 1 (used thermometer A)	16.0	16.0	16.0	18.0
Group 2 (used thermometer B)	14.0	19.0	22.4	19.2
Group 3 (used thermometer C)	22.0	21.0	18.3	21.2
Group 4 (used thermometer D)	22.7	22.8	22.2	22.7

*Table 2: Temperature readings from **four (4)** student groups and the electronic thermometer reading (°C).*

a) Explain which group is the **most precise** in their measurements.

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Question 4 continues

Marker use

b) Explain which group is the **most accurate** in their measurements.

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c) Assuming the precision of the thermometers **remains the same** when the experiment is to be conducted, state which group (1, 2, 3 or 4) and which thermometer (A, B, C, D) you would select to produce the most reliable results. Give a reason for your choice.

Group: .....

/1

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Thermometer: .....

/1

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Reason: .....

/2

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Total Q4

/8

Question 5

Marker use

A respirometer is a device that can be used to measure the rate of oxygen consumption of individual bees. A scientist wanted to measure the health of a hive. They theorised that the higher the average rate of respiration of the bees the better the health of the hive. They decided to select different bees from the hive and measure their respiration rates using the respirometer.

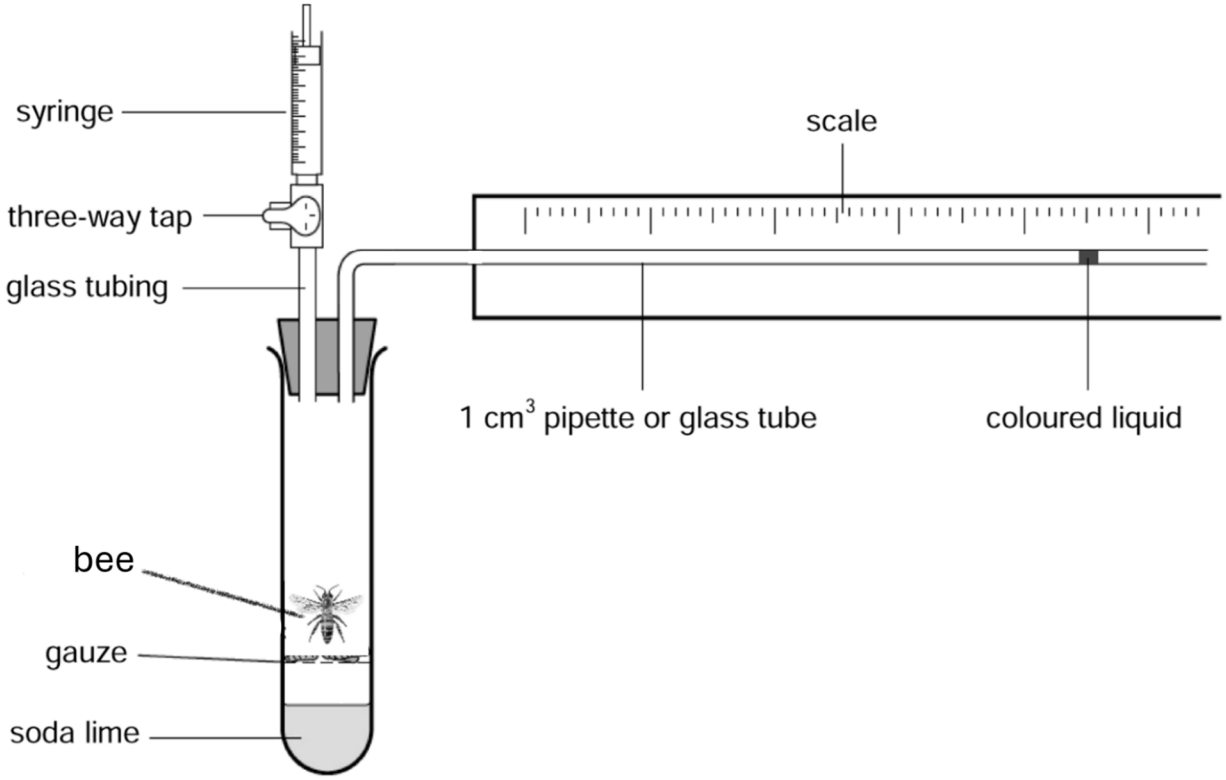

Figure 2: Respirometer with a bee.

Question 5 continues

Marker use

a) With some reference to Figure 2, give **step by step** instructions advising the scientist how to set up their experiment to collect meaningful results.

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b) Outline **two (2)** weaknesses of this approach to measuring hive health.

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Total Q5

/7

Acknowledgements

Sources:

Figure 1: https://www.nsw.gov.au/sites/default/files/noindex/2025-02/2019-hsc-biology.pdf

Table 2: (modified from)
https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2018/2018biology-cpr-w.pdf%20Q.11

Figure 2: https://rb.gy/htnnr2

End of Section A

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TASMANIAN ASSESSMENT, STANDARDS & CERTIFICATION

External Assessment 2025

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BIOLOGY

BIO315124

Section B

Pages: 16
Questions: 6
Information Sheet: 1

Suggested working time: 36 minutes

Instructions:

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C5	/ 36

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Section E	6	6	36 minutes	36 marks
Totals	**29**	**29**	**180 minutes (3 hours)**	**180 marks**

Criterion

You **must** make sure your answers address:

- Criterion 5 analyse the processes and mechanisms by which biological systems are regulated.

Question 6

Marker use

Anaerobic respiration is followed by aerobic respiration in eukaryotic cells.

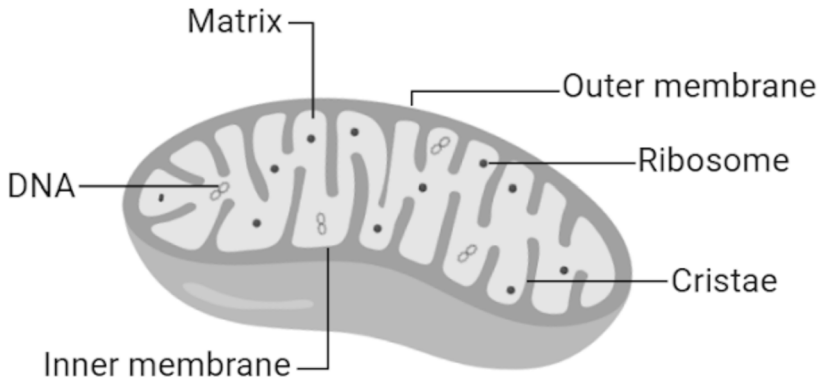

Figure 3: The mitochondrion.

a) Using Figure 3, state the **location** where the Krebs cycle and electron transport chain occur. /1

Krebs cycle: .....

Electron transport chain: .....

b) Outline **three (3)** key differences between aerobic and anaerobic respiration. /3

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Total Q6 /4

Question 7

Marker use

The following table shows the percentage of DNA bases found in one (1) DNA strand.

a) Complete the table.

/2

Base	A	C	G	T
DNA Template Strand	19			26
DNA Complementary Strand	26	32		

Table 3: Percentage (%) of each DNA base.

Spare diagram used (X) ☐

During DNA replication, enzyme A was responsible for unwinding the double helix by breaking hydrogen bonds and enzyme B was responsible for adding daughter nucleotides onto the DNA template strand.

b) Name the **two (2)** enzymes.

/1

Enzyme A .....

Enzyme B .....

Question 7 continues

Marker use

The semi-conservative model is currently the accepted model of how DNA replicates.

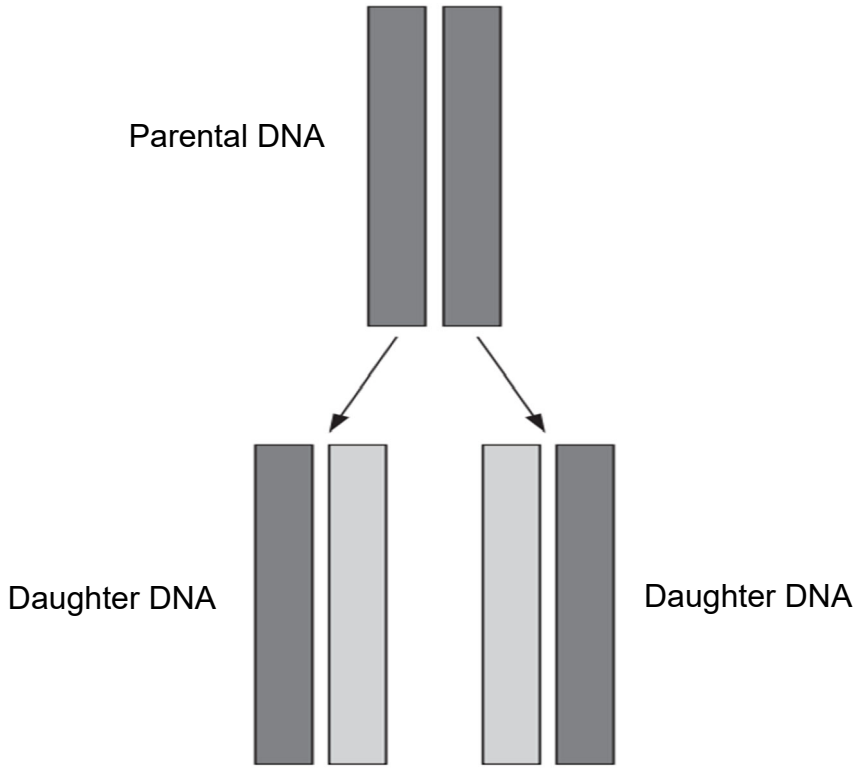

Figure 4: Semi-conservative model of DNA replication.

c) Using Figure 4, describe the semi-conservative model.

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Marker use

Refer to the Figure 5 diagram which shows a process that occurs in a eukaryotic cell.

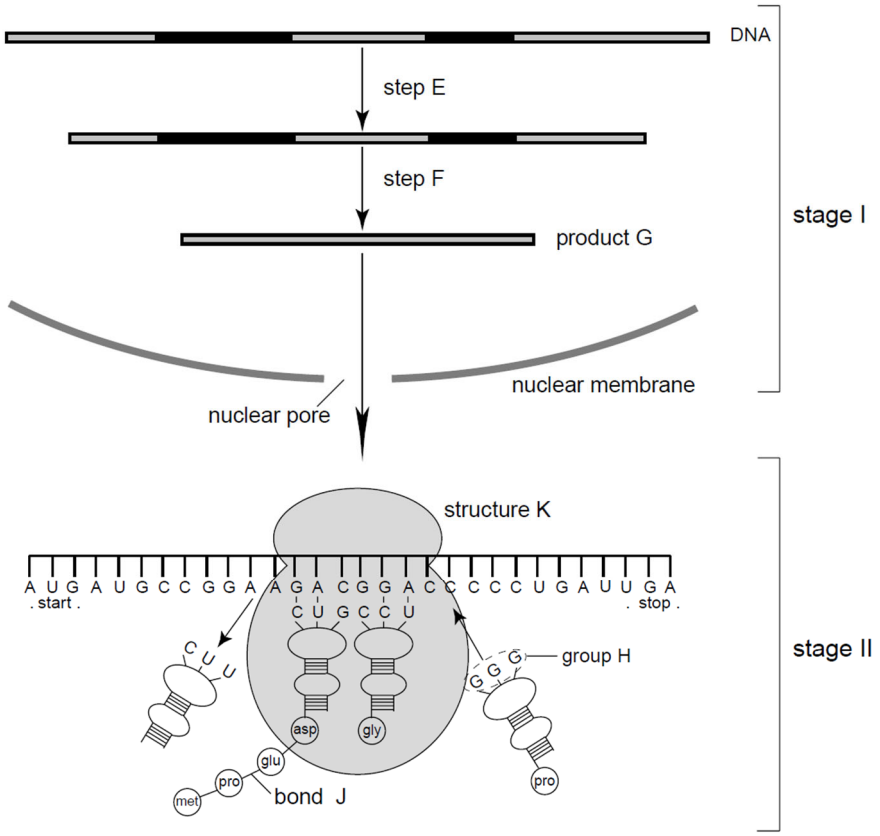

Figure 5: Model of protein synthesis.

d) Outline what happens in the nucleus during **step F**.

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e) Describe how **stage II** leads to the production of the polypeptide chain.

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Total Q7

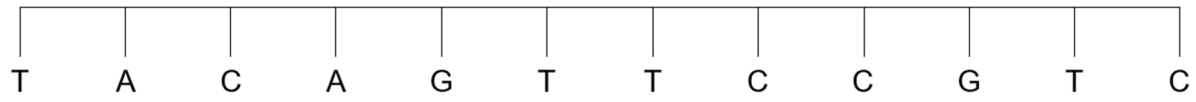
/10

Question 8

Marker use

Figure 6 below shows part of an original DNA sequence and a mutated DNA sequence.

DNA sequence



Mutated DNA sequence

Figure 6: Original and mutated DNA sequence.

a) Determine what impact this mutation may have on the resulting protein by giving the amino acid sequences in the table below **and** outlining the impact. /2

Original DNA sequence				
Mutated DNA sequence				

Table 4: Amino acid sequences.

Spare diagram used (X) ☐

Impact:

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b) Analyse why **more** codons exist than amino acids. /2

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..... **Total Q8** /5

Question 9

Marker use

Dihydrofolate reductase (DHFR) is an enzyme that catalyses the decomposition of folic acid in the human body.

Figure 7: Enzyme and its substrate.

Two (2) different types of inhibitors, A and B, are shown in Figure 8 below:

Figure 8: Inhibitors.

a) **State** which inhibitor is a competitive inhibitor and which one is a non-competitive inhibitor. /1

Competitive inhibitor: .....

Non-competitive inhibitor: .....

b) **Analyse** the effect that an increase in folic acid is likely to have on the action of inhibitor B. /2

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Question 9 continues

Marker use

The two (2) graphs in Figure 9 below show the activity of DHFR on the hydrolysis of folic acid.

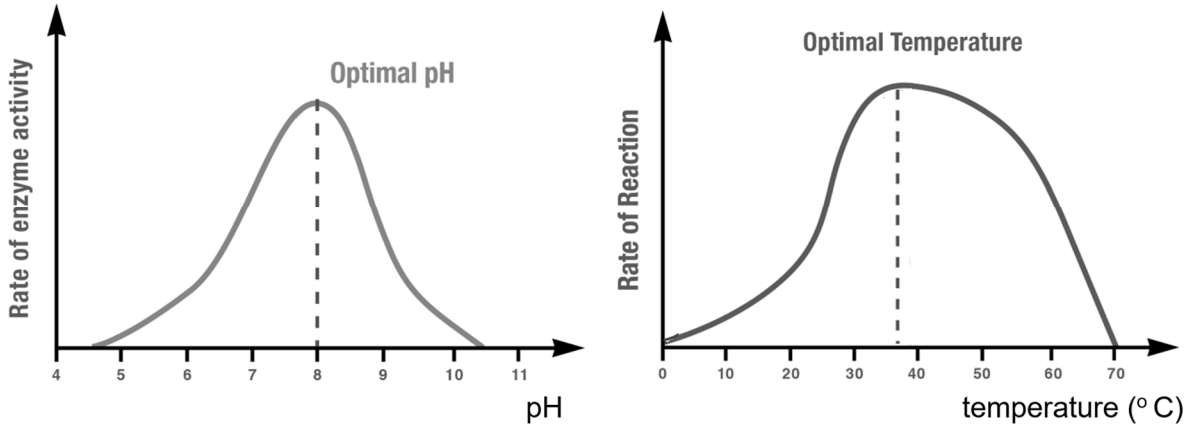

Figure 9: Optimum conditions for activity of DHFR.

c) Give **two (2)** conditions where the reaction will be fastest.

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The DHFR solution was refrigerated overnight at 4° Celsius. The next day after warming up to 30° C, a strong acid (HCl) was added to the solution along with more folic acid.

d) Explain why the folic acid did not hydrolyse.

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Total Q9

/6

Question 10

Marker use

The amount of CO_2 used by a shade plant at different light intensities is shown in Figure 10.

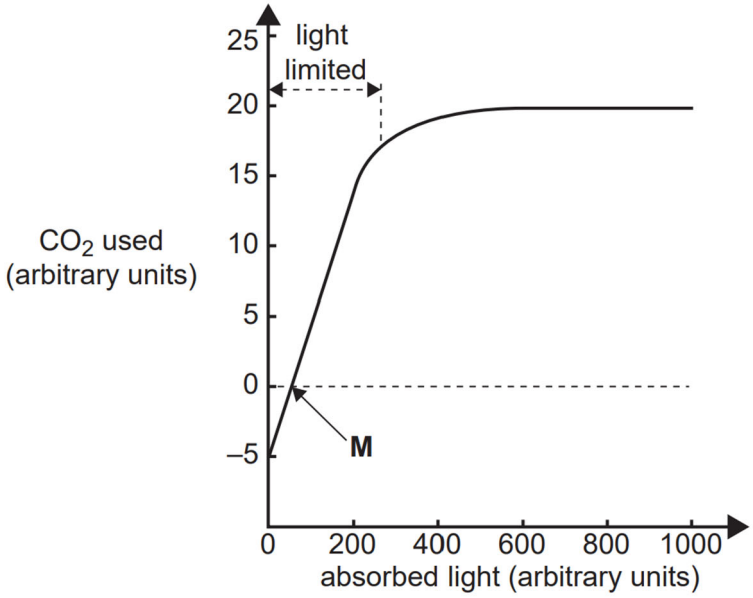

Figure 10: The effect of absorbed light on CO_2 used in shade plants.

a) **Outline** how the respiration rate of this plant can be measured.

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b) **Explain** what is happening at **point M** where the plant is not using any CO_2.

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/2

c) Assuming all reactants are in excess, **explain** why the graph flattens out.

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/2

Total Q10

/5

Question 11

Marker use

The bacterium *E.coli* lives in the guts of mammals and feeds on sugars such as lactose and glucose. *E.coli* prefers to use glucose as an energy source but can use lactose if required by firstly converting it into galactose and glucose.

The following Figure 11 outlines the significant regions of the *E.coli* genome (DNA) that enable the regulation of sugars required for cellular respiration.

CAP site	Lac I	Promoter	Operator	Lac Z	Lac Y	Lac A

Figure 11: Regions of the E.coli genome.

a) When there is no lactose present explain how the lac repressor prevents the transcription of the Lac Z gene. /2

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b) By referring to Figure 11, when glucose levels are low and lactose is present, explain how the lac operon ensures the continued production of glucose required for cellular respiration through the transcription of Lac Z. /3

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The Lac Y gene codes for the enzyme permease, which travels to become an integral protein in the cell membrane of *E.coli*.

c) Outline the function of permease. /1

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Total Q12 /6

Spare Diagrams

Question 7 a)

Base	A	C	G	T
DNA Template Strand	19			26
DNA Complementary Strand	26	32		

Table 3: Percentage (%) of each DNA base.

Question 8 a)

Original DNA sequence				
Mutated DNA sequence				

Table 4: Amino acid sequences.

Acknowledgements

Sources:

Figure 3: https://www.ahmadcoaching.com/2020/10/what-is-a-mitochondria-structure-function.html

Figure 4: (modified from) https://www.nsw.gov.au/sites/default/files/noindex/2025-02/2022-hsc-biology.pdf

Figure 5: https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2007biol2.pdf

Figure 9: (modified from) https://www.monash.edu/student-academic-success/biology/regulation-of-biochemical-pathways/factors-

Figure 10: https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2011biology1-w.pdf%20

End of Section B

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BIOLOGY

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Section C

Pages: 16
Questions: 6
Information Sheet: 1

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Marker use	
C6	/ 36

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Totals	**29**	**29**	**180 minutes (3 hours)**	**180 marks**

Criterion

You **must** make sure your answers address:

- Criterion 6 analyse homeostatic concepts, processes and interrelationships.

Question 12

Marker use

a) Fill in the following flow chart to demonstrate your understanding of thermoregulation.

/2

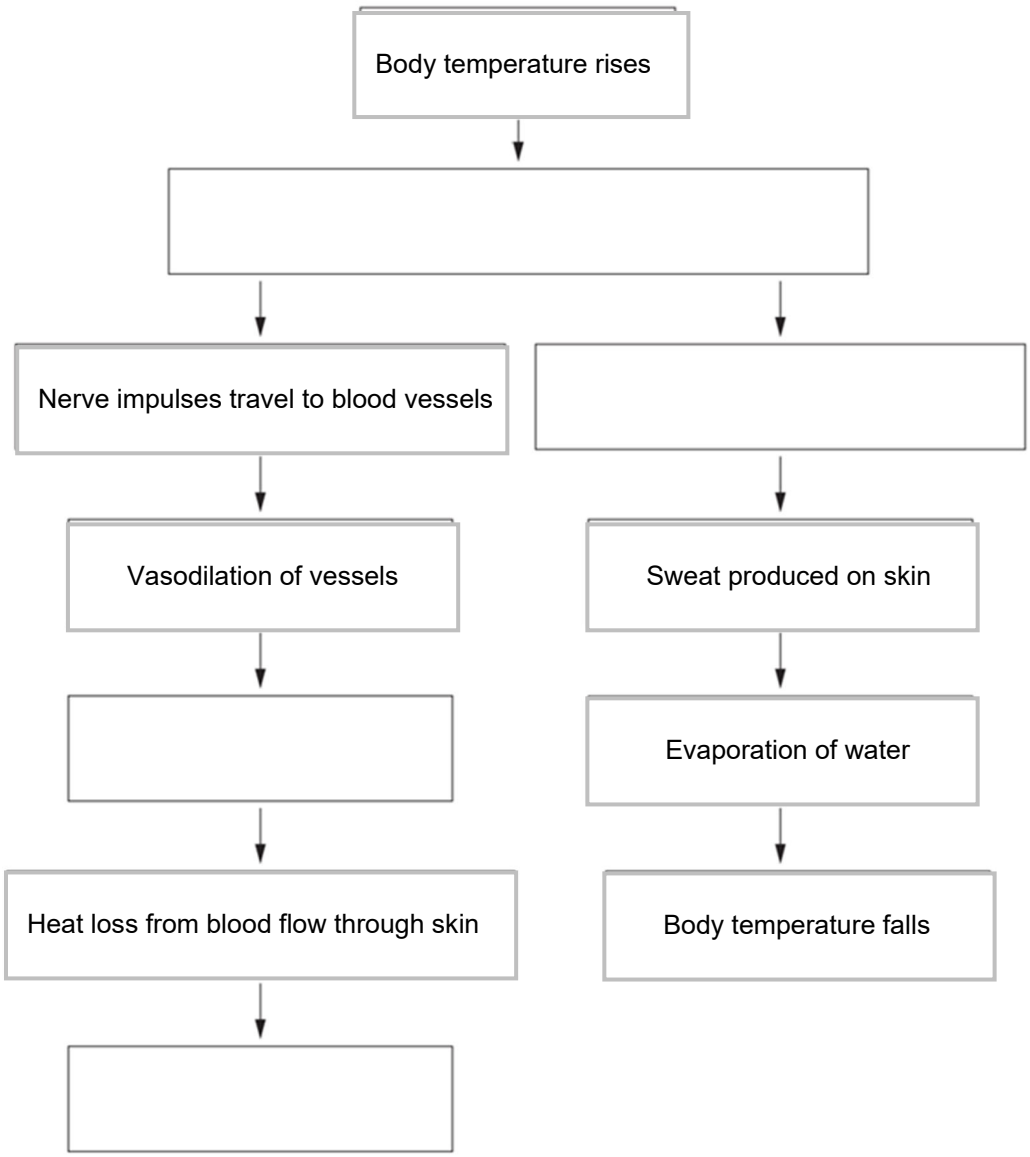

Figure 12: Temperature homeostasis.

Spare diagram used (X) ☐

b) Explain **negative feedback** in relation to temperature homeostasis.

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Total Q12

/4

Question 13

Marker use

Some plants have leaves that are adapted to dry environments to better enable them to conserve water. Two (2) such plants are shown in Figures 13 and 14 below.

Figure 13: Zygophyllum spp.

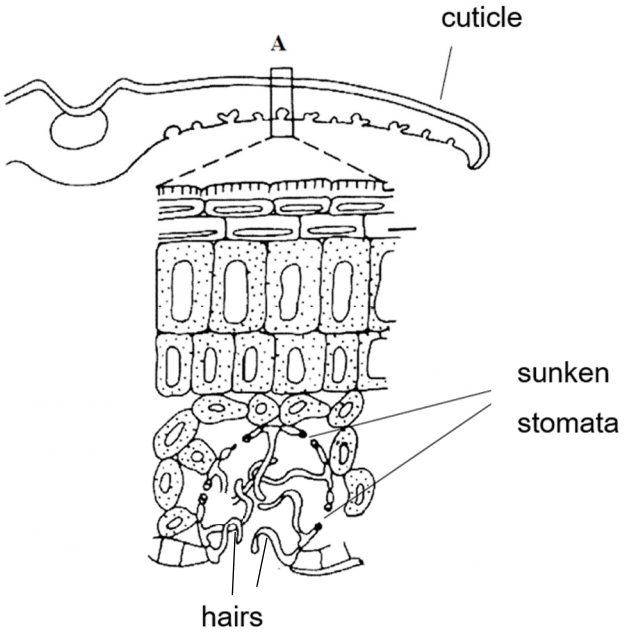

Figure 14: Cross section of a leaf.

a) **Name** the process by which water vapour escapes from the leaf.

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b) Explain how **two (2)** features, shown in either Figure 13 or 14, help minimise water loss in plant leaves.

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Total Q13

/5

Question 14

Marker use

a) **Describe** the process by which water is transported through a plant. In your answer, include:

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- the direction of water movement
- the role of root pressure
- the cohesion of water molecules.

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b) Outline how the following **two (2)** factors influence transpiration rate in plants.

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Increase in light intensity

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Decrease in humidity

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Total Q14

/6

Question 15

Marker use

/5

Insulin is a hormone produced to control blood glucose levels. With reference to an **increase** and **decrease** in blood sugar, describe the role of insulin in controlling glucose in the blood.

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Total Q15

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Question 16

Marker use

A nerve consists of many neurons. The action potential of a single neuron is shown below in Figure 15.

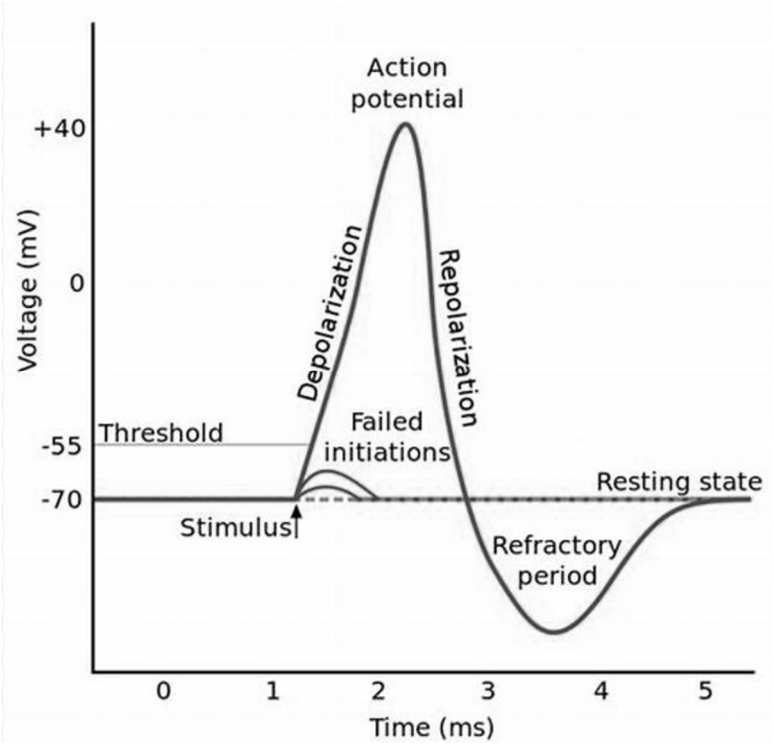

Figure 15: Action potential of a single neuron.

a)

i. **Identify** the voltage required to initiate action potential.

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ii. Once the threshold is reached, **explain** what happens to the ions across the neuron membrane in depolarisation.

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Question 16 continues

Marker use

iii. **Explain** how the sodium potassium pump re-establishes the resting state after the refractory period. /2

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Consider that the action potential has now reached the terminal end of a neuron.

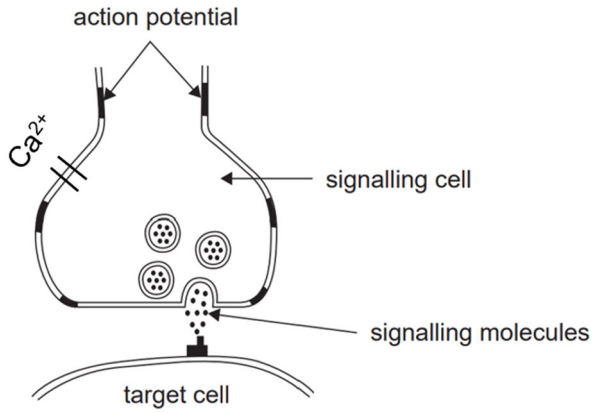

Figure 16: Action potential and the terminal end.

b) Describe how the action potential results in the target cell receiving the signal. /4

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Total Q16 /9

Question 17

Marker use

Antidiuretic hormone (ADH) is a hormone involved in the regulation of blood plasma solute concentration. The graph in Figure 17 below shows the concentration of ADH in human blood at different plasma solute concentrations.

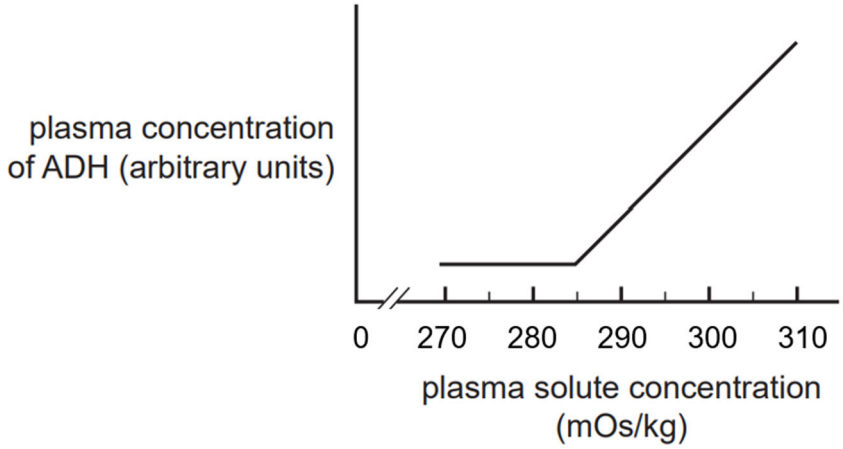

Figure 17: Concentration of ADH at different plasma solute concentrations.

a) Stimulation of ADH release requires the plasma solute concentration to be above a certain value. **Give** that value. /1

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Osmoreceptors detect changes in blood plasma solute concentration and stimulate magnocellular neurons. Magnocellular neurons are special neurons that synthesise ADH, storing ADH in vesicles until stimulated to release it. ADH diffuses across a gap and into a capillary. This process is shown in Figure 18.

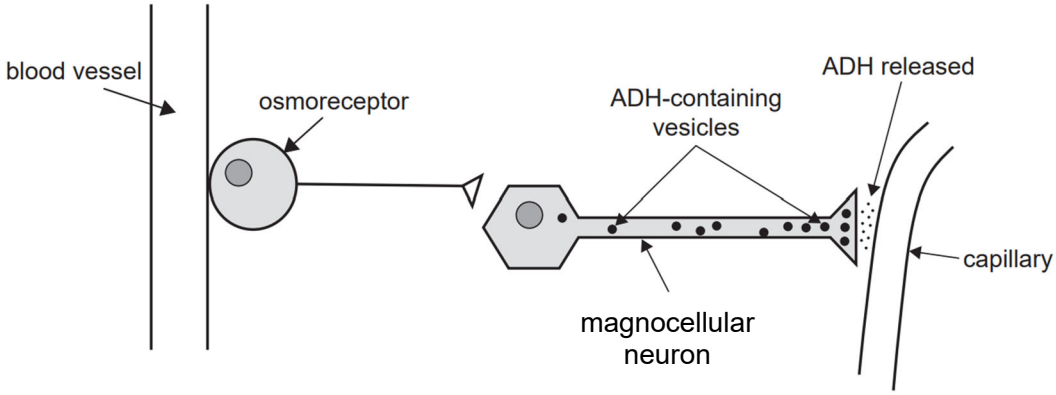

Figure 18: Neuron and hormone transmission.

Question 17 continues

Marker use

Several forms of message transmission are shown in Figure 18.

b) Predict with a **reason** which form of transmission would be the slowest.

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When ADH is released into the capillary it travels to the effectors and this maintains water homeostasis.

c) Give a **detailed account** of how the action of this hormone maintains water homeostasis.

/4

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Total Q17

/7

Spare Diagrams

Question 12 a)

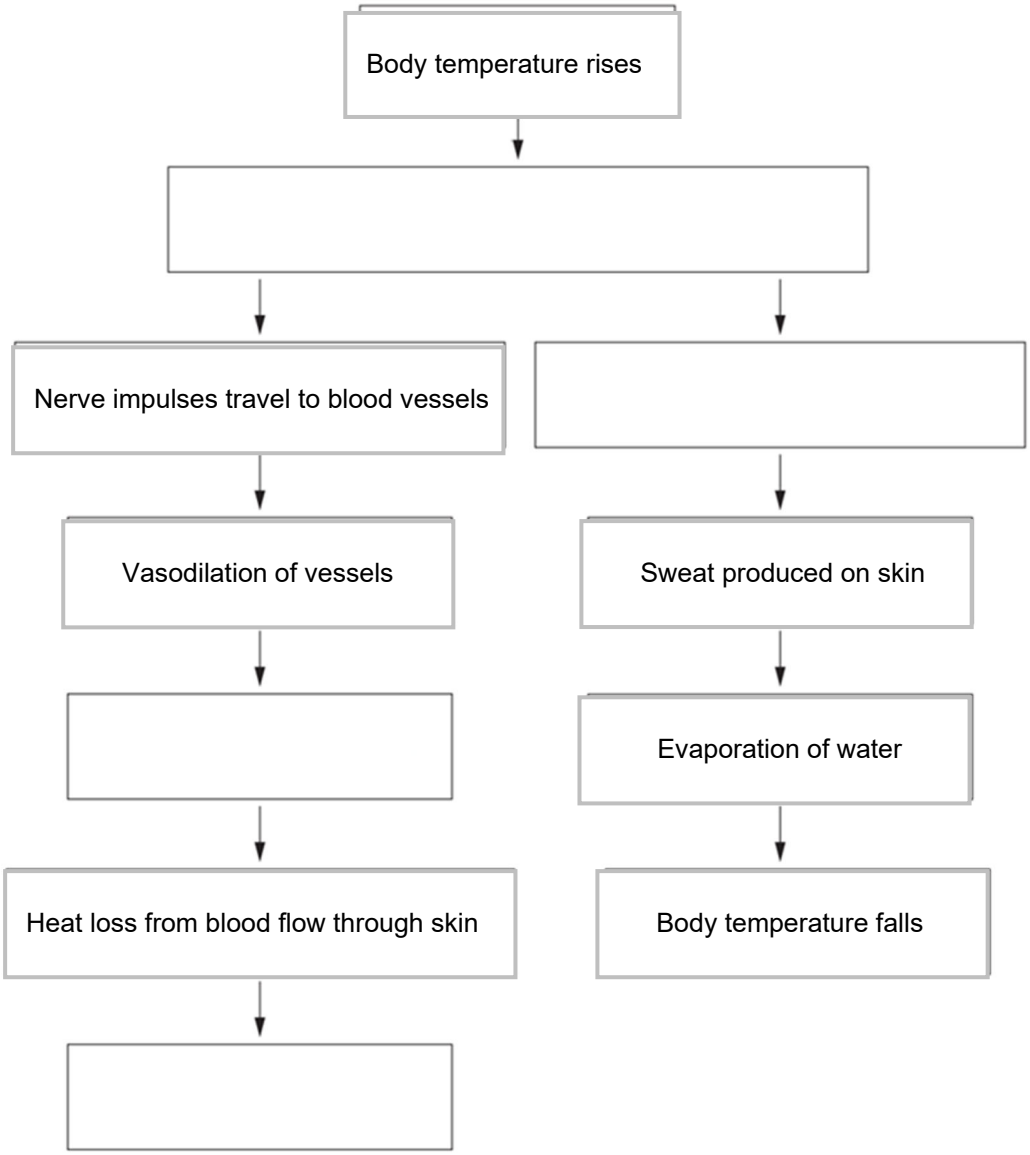

Figure 12: Temperature homeostasis.

Acknowledgements

Sources:

Figure 12: (modified from) https://www.nsw.gov.au/sites/default/files/noindex/2025-02/2019-hsc-biology.pdf

Figure 15: https://teachmephysiology.com/nervous-system/synapses/action-potential/

Figure 16: (modified from) https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2021/2021biology-cpr-w.pdf

Figure 17: (modified from) https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2016/2016biology-w.pdf

Figure 18: (modified from) https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2016/2016biology-w.pdf

End of Section C

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BIOLOGY

BIO315124

Section D

Pages: 16
Questions: 6
Information Sheet: 1

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each question.
  - A spare diagram has been provided at the end of this section. Indicate in the box provided if you have used the spare diagram.
- Write your answers in the spaces provided in this exam paper.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
- The Biology Information Sheet can be used throughout this exam.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use	
C7	/ 36

Blank Page

Guide to Exam Structure

	Questions available	Questions to answer	Suggested working time	Marks available
Section A	5	5	36 minutes	36 marks
Section B	6	6	36 minutes	36 marks
Section C	6	6	36 minutes	36 marks
Section D	6	6	36 minutes	36 marks
Section E	6	6	36 minutes	36 marks
Totals	**29**	**29**	**180 minutes (3 hours)**	**180 marks**

Criterion

You **must** make sure your answers address:

- Criterion 7 analyse concepts, processes and interrelationships as organisms respond to pathogens.

Question 18

Marker use

Malaria is a disease caused by a single-celled *Plasmodium* species. It is transmitted by female mosquitoes.

a) State the **term** used to identify the role of the mosquitoes in transmission.

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b) Give **one (1)** similarity and **one (1)** difference between a parasite and a virus.

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c) Outline how **one (1)** physical and **one (1)** chemical barrier assist in preventing malaria infection.

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d) With **named** examples discuss **two (2)** different ways, **other than** your answer to Question 18 part a), in which an infectious disease can be transmitted.

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Total Q18

/8

Question 19

Marker use

Whilst not much research currently exists around the types of immunity in Tasmanian snakes, Table 5 describes possible ways that natural immunity may be acquired by individuals in a Tasmanian snake population.

Letter	Description of Immunity
A	Passing of antibodies to offspring through egg yolk, providing temporary immunity.
B	Development of immunity to certain bacteria over time.

Table 5: Tasmanian snake immunity.

a) Using **examples** from Table 5, compare and contrast the **two (2)** types of natural immunity.

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A human was bitten by a Tasmanian snake and a serum was administered.

b) **Circle** the key word/s that indicate the type of treatment required:

/1

natural **artificial** **passive** **active**

Total Q19

/5

Question 20

Marker use

Macrophages and neutrophils are white blood cells that operate in the innate immune system. One such white blood cell is shown in Figure 19.

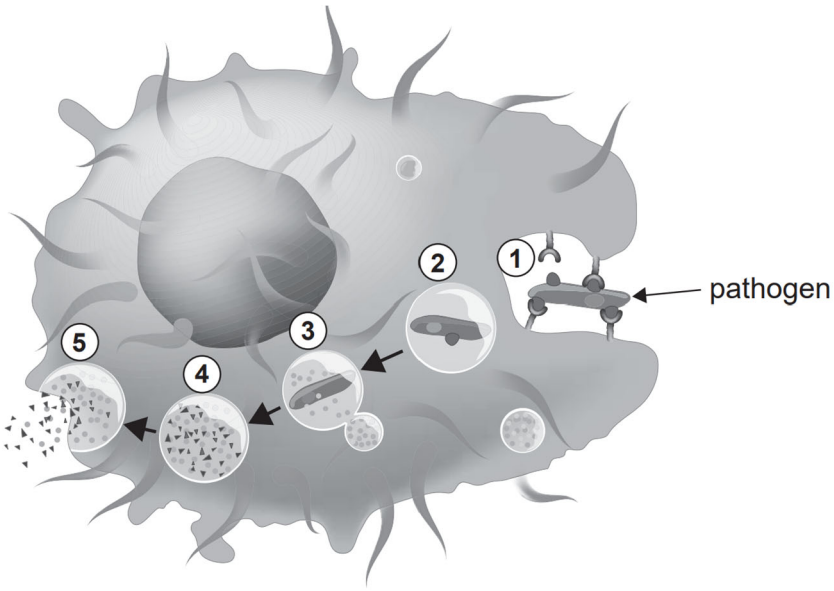

Figure 19: Phagocytosis in white blood cells.

a) Briefly outline the steps involved in phagocytosis.

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Question 20 continues

Marker use

Figure 20 shows what happens in the second line of defence when an unknown pathogen enters the human body through an injury and phagocytes move towards the pathogen.

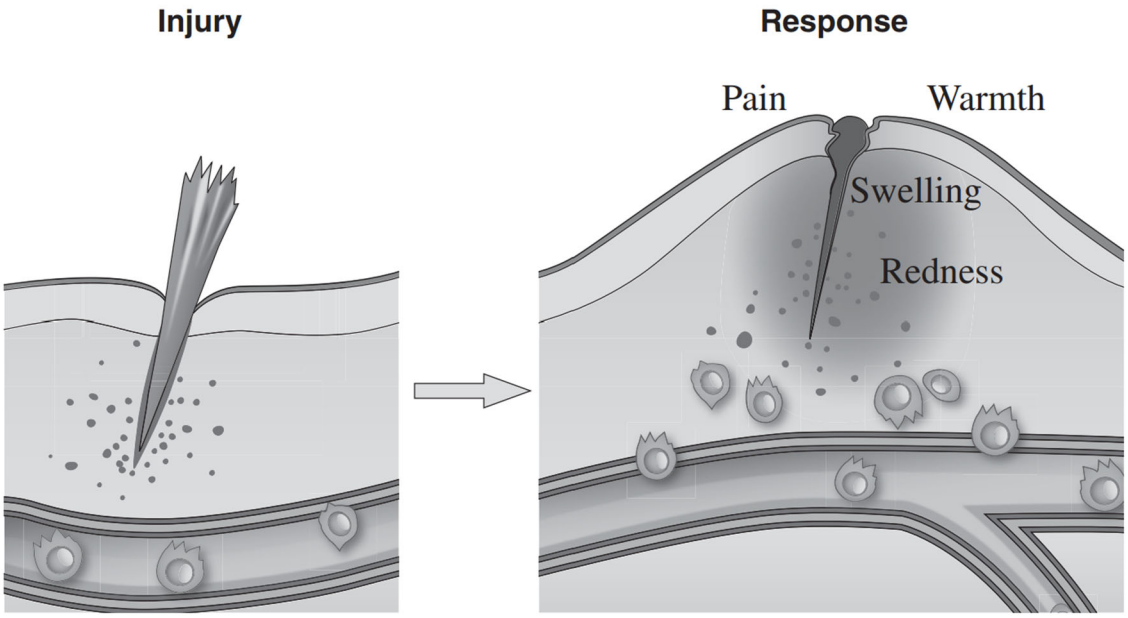

Figure 20: Inflammatory response.

b) **Explain** the response to the injury which leads to the redness, swelling, warmth and pain to the area.

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Total Q20

/7

Question 21

Marker use

Immune cells have many kinds of receptors on their plasma membranes as well as different kinds of self-antigens. By examining other cells for the presence of self and non-self-antigens, immune cells can determine the kind of threat other cells might pose to the organism. The more non-self-antigens an immune cell detects, the greater will be its reaction against a cell it encounters. Examine the immune cell in Figure 21, for non-self-antigens and receptors.

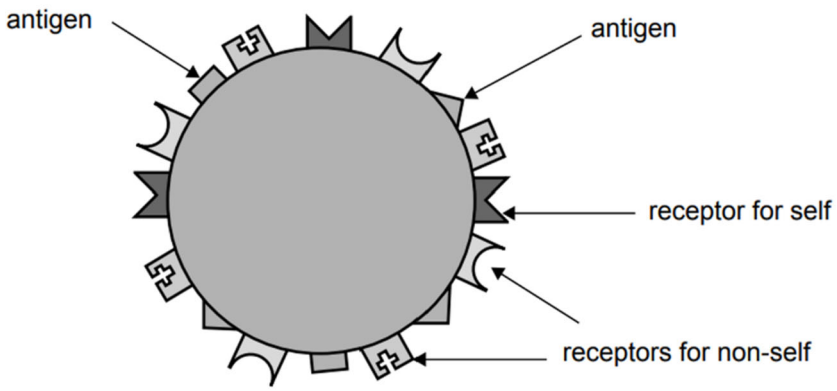

Figure 21: Immune cell X.

Immune cell X encounters the following **three (3)** cells:

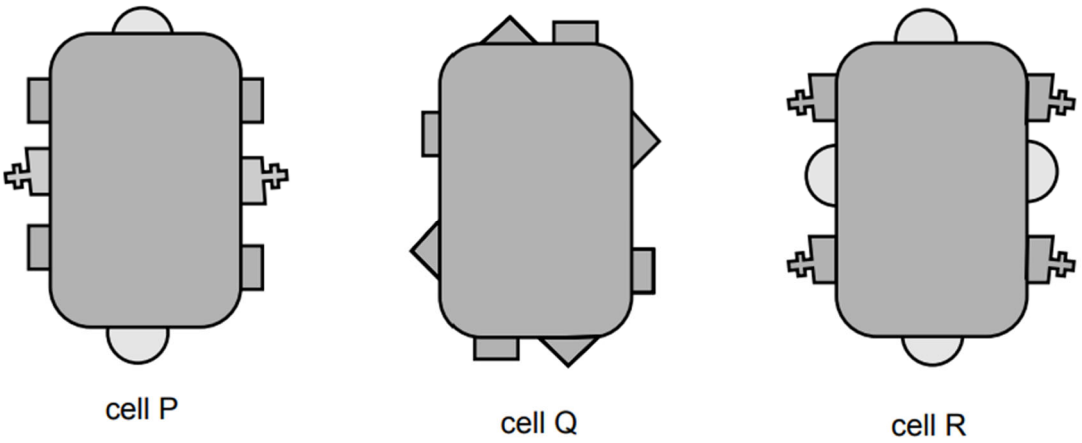

Figure 22: Other cells, P, Q and R.

Question 21 continues

Question 21 continued

Marker use

Justify which cell, in Figure 22 (P, Q or R) is likely to cause the **greatest** immune response and which is likely to cause the **least** immune response.

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Total Q21

/4

Question 22

Marker use

In the cell-mediated response, different immune cells work together to identify and respond to foreign antigens that have infiltrated human cells. The process is outlined in Figure 23.

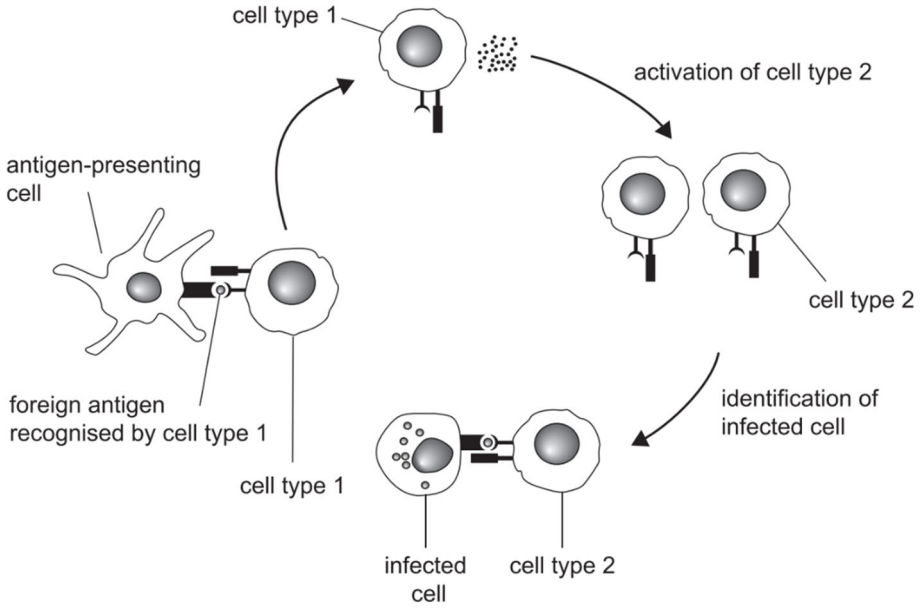

Figure 23: Cell-mediated response.

a) Select **four (4)** names from the list below to **fill in** Table 6.

Immune cell list

Cytotoxic (killer) T-cell	Mast cell	T lymphocyte
B lymphocyte	Neutrophil	Dendritic cell
Human tissue cell	Memory B cell	Memory T cell

Immune cells shown in Figure 23	Name of immune cells *(selected from the **list**)*
Antigen presenting cell	
Cell Type 1	
Cell Type 2	
Infected cell	

/2

Table 6: Name of immune cells found in Figure 23.

Spare diagram used (X) ☐

Question 22 continues

Marker use

b) Beginning with the antigen presenting cell in Figure 23, describe in detail the process of the **cell-mediated response** and how it leads to the destruction of infected cells.

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Total Q22

/7

Question 23

Marker use

The diagram in Figure 24 shows the changes in concentration of an antibody produced in response to a particular pathogen.

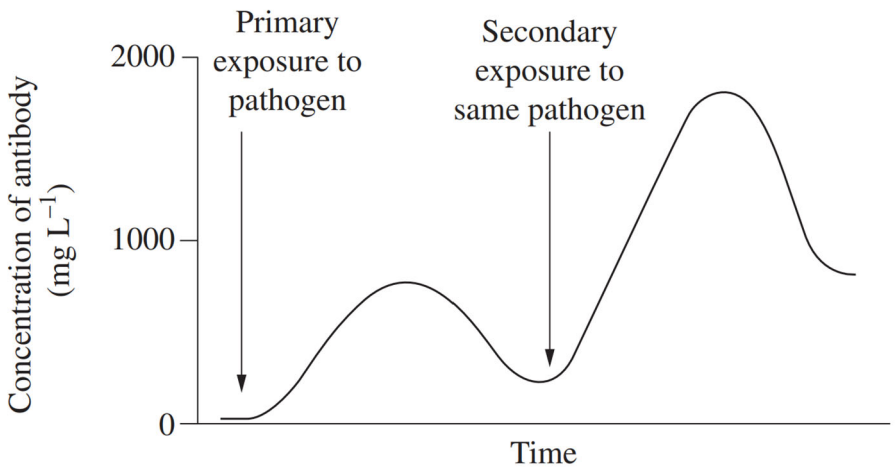

Figure 24: Antibody concentration over time.

Two (2) students, X and Y, were exposed to the pathogen at the same time. Student X had previously been vaccinated against the pathogen and Student Y had never been exposed to it. Only **one (1)** blood sample from both students was taken, soon after exposure.

Blood Samples	Student X	Student Y
A	250	1500
B	1500	1000
C	1000	1500
D	1500	250

Table 7: Blood samples showing the concentration of antibody in blood (mg L^{-1}).

a) **State** the letter in Table 7 corresponding to the correct blood sample results for students X and Y.

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Question 23 continues

Marker use

b) Using the information in Figure 24, **justify** your answer to part a).

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Total Q23

/5

Spare Diagrams

Question 22 a)

Immune cells shown in Figure 23	Names of Immune cells *(selected from the **list**)*
Antigen presenting cell	
Cell Type 1	
Cell Type 2	
Infected cell	

Table 6: Name of immune cells found in Figure 23.

Acknowledgements

Sources:

Figure 19:
https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2019/2019biology-cpr-w.pdf

Figure 20: https://www.nsw.gov.au/sites/default/files/noindex/2025-02/2022-hsc-biology.pdf

Figure 21 & 22: (modified from)
https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/biol1_exam_2007.pdf

Figure 23: https://www.vcaa.vic.edu.au/sites/default/files/2025-03/2024biology-w.pdf

Figure 24 & Table 7: (modified from)

https://www.nsw.gov.au/sites/default/files/noindex/2025-02/2019-hsc-biology.pdf

End of Section D

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BIOLOGY

BIO315124

Section E

Pages: 16
Questions: 6
Information Sheet: 1

Suggested working time: 36 minutes

Instructions:

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Marker use	
C8	/ 36

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Guide to Exam Structure

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Section E	6	6	36 minutes	36 marks
Totals	**29**	**29**	**180 minutes (3 hours)**	**180 marks**

Criterion

You **must** make sure your answers address:

- Criterion 8 analyse cell division, genetics and evolution to explain biological persistence and diversity.

Question 24

Marker use

a)

i. Complete the following table giving the **correct order** and **names of the stages** in the cell cycle.

/4

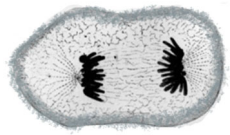
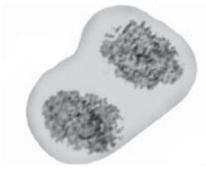
Picture	Order of stages (1-4)	Name of stage
		
		
		
		

Table 8: Stages of mitosis.

ii. List **two (2)** differences between mitosis and meiosis.

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Question 24 continues

Marker use

A diagram of the cell cycle is shown in Figure 25.

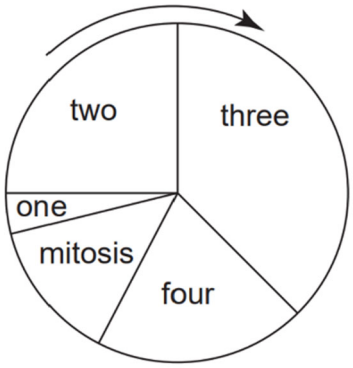

Figure 25: Cell cycle.

Stages two, three and four are not part of cell division.

b) **Explain** whether a cell is likely to be larger when it is in stage two or stage four.

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Total Q24

/7

Question 25

Marker use

Syndactyly is a condition in which two (2) or more fingers or toes do not separate during foetal development. An individual may have either complete or partial webbing.

Figure 26 shows a hand from two (2) individuals who have each been born with syndactyly.

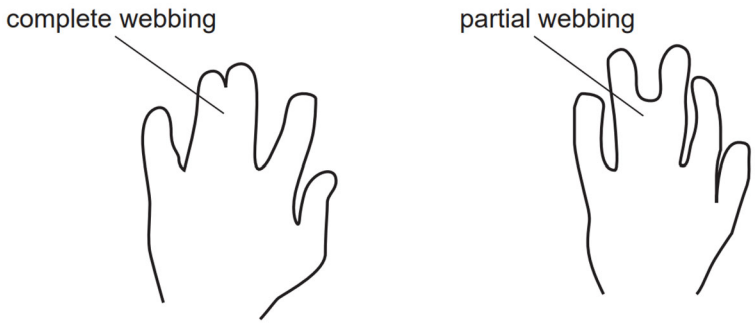


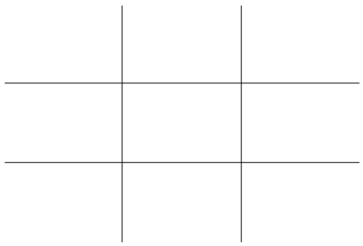
Figure 26: Phenotype of syndactyly.

Syndactyly is inherited as an autosomal dominant trait. Ruby and her father have syndactyly. Ruby's mother has fingers and toes without syndactyly. Ruby marries Jonah, who has normal fingers and toes.

Ruby and Jonah decide to have a baby.

a) Using a Punnett square give the expected genotypes and phenotypes of the offspring, and determine the **chance** that the baby will have syndactyly.

/3



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Question 25 continues

Marker use

In *Biston* spp. colour is sometimes inherited in a non-Mendelian way. The simplified pedigree in Figure 27 shows that 100% of the offspring born are all the same colour, yet all offspring are a different colour to both parents.

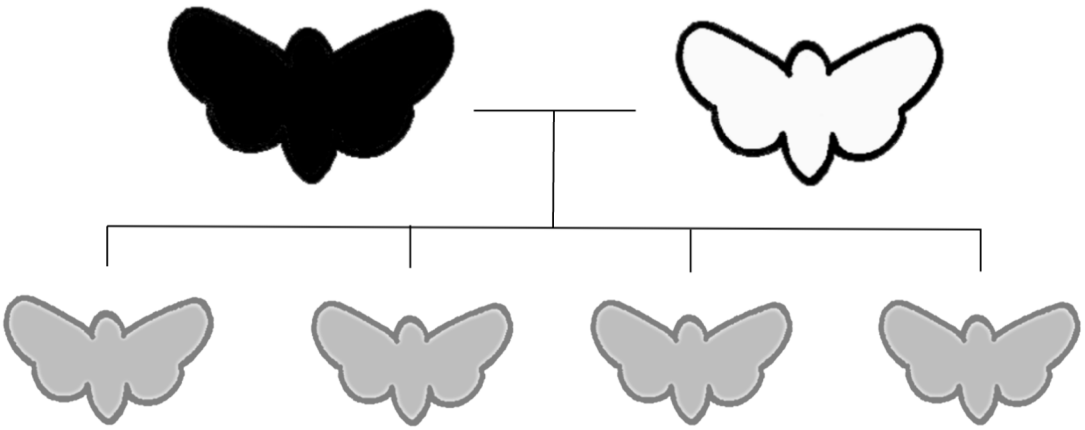
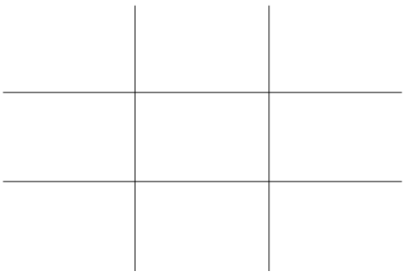


Figure 27: Pedigree for Biston spp.

b) Using a Punnett square, explain how colour is inherited in *Biston* spp.

/3



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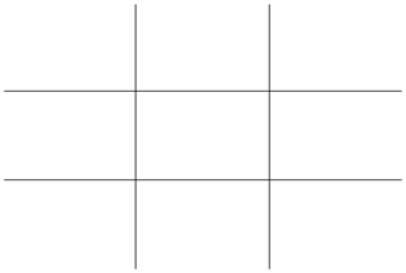
Question 25 continued

Marker use

Erythrocytes are highly specialised cells that form in the bone marrow. These cells have the primary function of transporting oxygen and carbon dioxide. A person's ABO blood type can be determined by the presence or absence of specific antigens on the surface of their erythrocytes.

c) Using **appropriate notation**, complete a Punnett square to determine how **four (4)** different blood types can be inherited from just **two (2)** parents.



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Total Q25

/9

Question 26

Marker use

Figure 28 shows a human pedigree. Shaded individuals in the pedigree have a genetic condition. Individuals marrying into the family, that is individuals II–1, II–4 and II–6, have no history of the condition in their families.

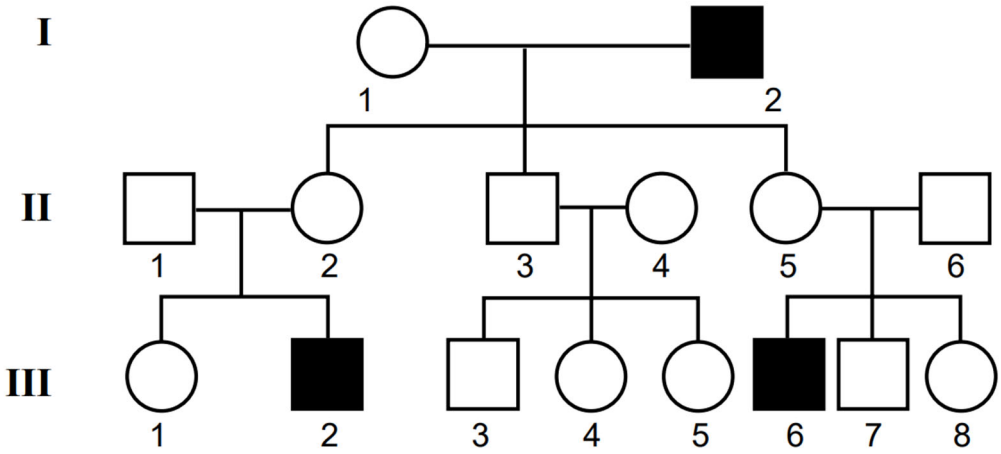

Figure 28: Human pedigree for a genetic condition.

Determine whether the inheritance is most likely to be **recessive** or **dominant**, **autosomal** or **sex-linked** by referring to specific **examples** in the pedigree.

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Total Q26

/4

Question 27

Marker use

Female jack jumper ants (*Myrmecia pilosula*) have a single pair of chromosomes. During meiosis, crossing over occurs. Figure 29 shows the crossing over and the position of three (3) genes on the chromosomes.

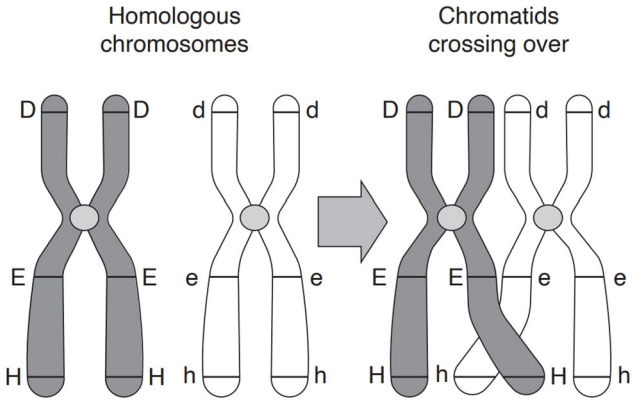

Figure 29: Crossing over in meiosis I.

a) Define the term 'homologous' with reference to Figure 29.

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b) Analyse the **significance** of crossing over for the jack jumper ants.

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c) Name another way in which genetic variation is usually **increased** in the gametes of:

/1

Sexually reproducing organisms

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Asexually reproducing organisms

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Question 27 continues

Marker use

/2

d) Draw the chromosomes of the **four (4)** possible gametes after Meiosis II has occurred for the jack jumper ants. Include the alleles for each gene.

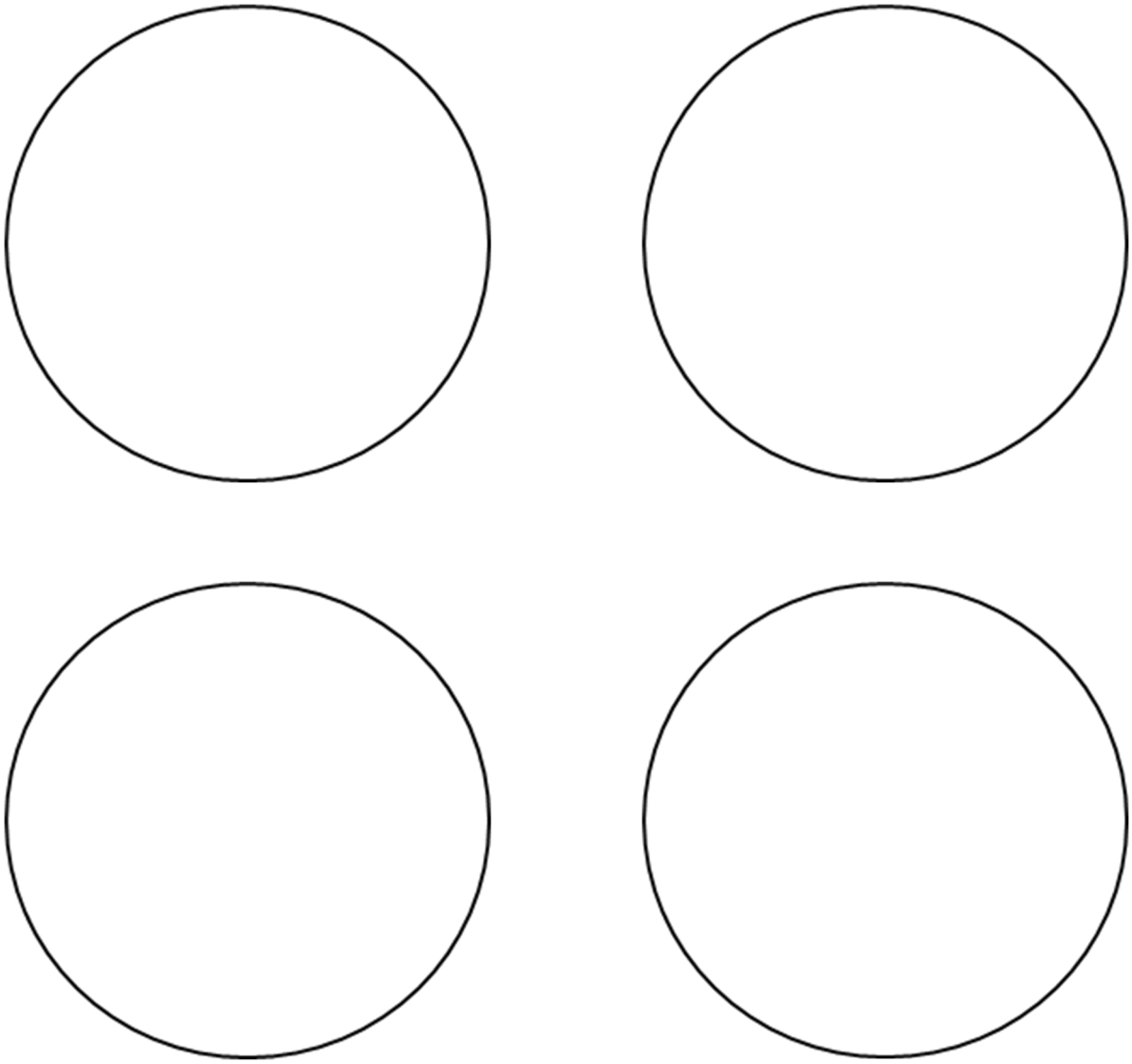

Figure 30: Gametes in jack jumper ants.

Spare diagram used (X) ☐

Total Q27

/6

Question 28

Marker use

In the mid-1960s, DDT was widely used as an insecticide against mosquitoes. The sensitivity to insecticide in mosquitoes is determined by a single gene that has two (2) alleles.

allele 1: resistant to DDT

allele 2: sensitive to DDT

Over several years genotypic frequencies were measured in a population of mosquito larvae. Figure 31 below shows the results.

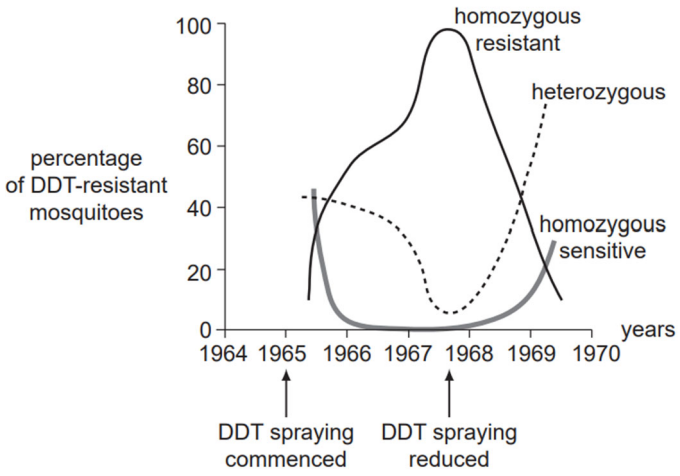

Figure 31: Genotypic frequencies in mosquito larvae.

a) **Explain** why the percentage of homozygous sensitive mosquitoes plummeted after 1965. /2

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b) **Analyse** the change in homozygous resistant mosquitoes after DDT spraying was reduced. /2

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Total Q28 /4

Question 29

Marker use

Rock wallabies, *Petrogale lateralis pearsoni*, on Pearson Island off the coast of South Australia have had no genetic contact with mainland rock wallabies since they were isolated by rising sea levels at the end of the last glacial period, around 10 000 years ago.

Scientists have shown that the current Pearson Island population has low genetic diversity.

a) Explain how a **small, isolated** population such as *Petrogale lateralis pearsoni* may have a lower genetic diversity than mainland populations. /2

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Despite the Pearson Island rock wallabies' lack of genetic diversity, the population size has been maintained over many generations. In fact, the wallabies appear to be thriving.

b) Suggest **one (1)** reason as to why the wallabies appear to be thriving. /1

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c) Explain how **geographical isolation** of *Petrogale lateralis pearsoni* could lead to the eventual speciation from the mainland wallaby populations. /3

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Total Q29 /6

Spare Diagrams

Question 27 d)

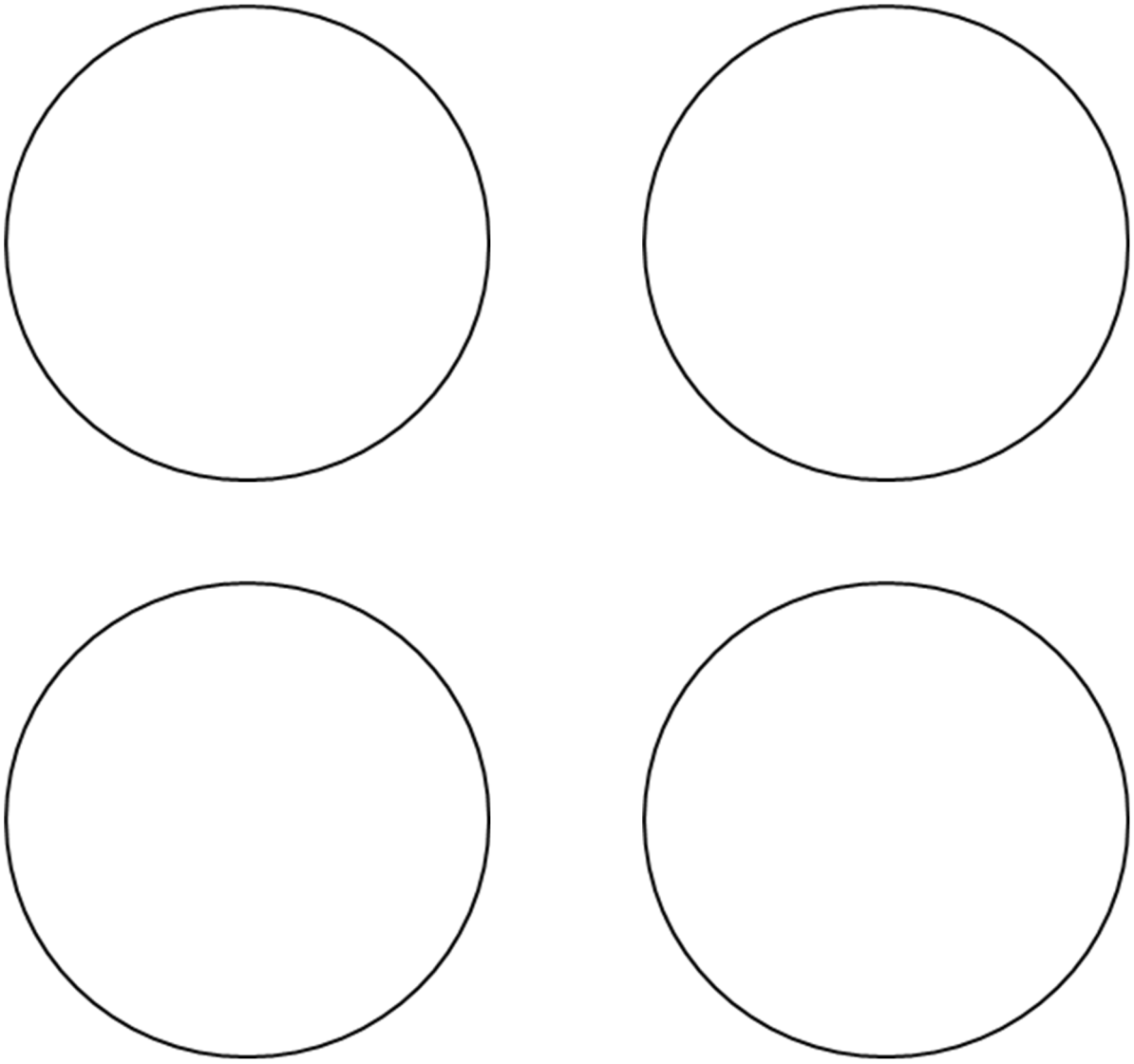

Figure 30: Gametes in jack jumper ants.

Acknowledgements

Sources:

Table 8: (modified from)
https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2012/2012biology2-w.pdf

Figure 25:
https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2011biology2-w.pdf

Figure 26: (modified from)
https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2012/2012biology2-w.pdf

Figure 28: https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2008biol2-w.pdf

Figures 29 & 30: https://www.nsw.gov.au/sites/default/files/noindex/2025-07/2024-hsc-biology-cc.pdf

Figure 31:
https://www.vcaa.vic.edu.au/sites/default/files/Documents/exams/biology/2010biology2-w.pdf

End of Section E

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